Comment

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Introduction

This is a rich and provocative paper, full of ideas and insights on how to use panel data on industries and sectors to test models of nominal rigidities and their implications for labor markets. Without doing proper justice to all that is in this paper, I would summarize its contribution as providing two empirical facts and an argument.

The first fact is that expenditures on durables fall proportionately by more than expenditures on nondurables in a recession. Theoretically, expenditures on durables are a small fraction of the stock of the durable, a direct consequence of small rates of depreciation of the stocks. Therefore, if consumers want to keep the level of their stock of durables in line with the level of their consumption of nondurables, they have to proportionately decrease the expenditure on durables by more than the expenditure on nondurables. Empirically, it is well known that aggregate durable spending is more volatile than nondurable spending over the business cycle. The authors further show that there is a statistically significant positive correlation between the durability of a sector and the cyclicality of employment or expenditures in that sector.

Second, the authors estimate the following regression equation:

$$\log(S_{it}) = \beta \log(\text{lifespan}_i) \times \log(Y_t) + \alpha_t + \varepsilon_{it},$$

where S_{it} is the share of output paid to production labor in industry i at date t, lifespan$_i$ is the average years of duration of a good in sector i, Y_t is aggregate output, α_t are year dummies, and ε_{it} are errors. They find that more durable goods have labor shares that are more sensitive to the business cycle: $\beta > 0$.

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To get a different perspective on this result, consider a world with two goods, one that is nondurable (c) and so has a life span of 1, while the other is a durable (x) with a life span of N years. Using small letters to denote logs of capital letters, the regression equation can be written simply as:

$$s_{xt} - s_{ct} = \beta \log(N) y_t + \varepsilon_{xt} - \varepsilon_{ct}. \tag{1}$$

Therefore, another way to state the authors' finding is that the relative labor share of durables is procyclical.

How does one go from these two empirical observations to their conclusion that "We find evidence in support of Keynesian labor demand"? The authors' argument goes as follows. A crucial idea of Keynesian economics is that prices are sticky and production is determined by demand. Therefore, when we enter a recession and demand for firms' goods falls, instead of cutting prices, they cut production and fire workers. By reducing their workforce, firms will be increasing the marginal product of labor relative to wages, which serves to lower the marginal cost of production. Therefore, with sticky prices and lower marginal costs, the markup rises in recessions. Now, in durable-goods sectors, the first fact established by the authors is that demand falls by more in a recession. Therefore, this mechanism will be stronger in durable-goods sectors, so their markup will rise by more in a recession. Finally, under some assumptions on production that are satisfied in many macro models, the labor share is a measure of the inverse of the markup. Putting it all together, Keynesian models would predict that the labor share is more procyclical in durable goods, matching the authors' second empirical finding.

Working More Slowly through the Argument

There are many steps in this argument. To understand it better, I use a simple model of durables and sticky prices that relies on three pillars.

The Relative Expenditure on Durables

I start with the demand side of the economy. There is a representative agent that solves the problem:

$$\max E\left[\sum_{t=0}^{\infty}\beta^t\left(\log(C_t) + \psi \log(D_t) - \frac{\phi L_t^2}{2}\right)\right],$$

$$P_{C,t}C_t + P_{X,t}X_t + B_t \leq W_tL_t + \Pi_t + (1 + i_{t-1})B_{t-1},$$
$$D_t = (1 - \delta)D_{t-1} + X_t.$$

The first line shows the intertemporal preferences, separable in the consumption of nondurables (C_t), durables (D_t), and hours worked (L_t). Agents spend resources to buy each of the two goods, and receive labor income in exchange for their work. The second line shows their budget constraint, where B_t are bonds they hold as savings, and Π_t are profits received from firms. Finally, in the third line is a standard geometric-depreciation model of the law of motion for durables, where δ is the depreciation rate, and X_t is the expenditure on durables.

The first-order condition with respect to expenditure on durables is:

$$\gamma_t P_{X,t} = \frac{\psi}{D_t} + \beta(1 - \delta)E_t(\gamma_{t+1}P_{X,t+1}),$$

where γ_t is the nominal marginal utility of income (the Lagrange multiplier on the budget constraint). I will focus on the case where the good is minimally durable; that is, where δ is very close to 1. The results that follow would become stronger as δ becomes smaller. When δ is close to 1, the second term on the right-hand side of this equation is approximately zero. Combining it with the optimality condition with respect to nondurable consumption gives the relative demand for durables:

$$d_t - c_t = p_{ct} - p_{xt},$$

where small letters denote logs of variables.

Log-linearizing the law of motion for durables around a steady-state, we get:

$$d_t = \delta x_t.$$

Again, with the assumption that δ is close to 1, this approximation is very close to being exact. But, as long as $\delta < 1$, the investment on durables will fluctuate by more than the stock of durables.

Combining these two equations, we obtain the key relation for the relative spending on durables:

$$\delta x_t - c_t = p_{ct} - p_{xt}. \tag{2}$$

We can see already how this standard model of the demand for durables can go a long way toward matching the first empirical finding of the authors. If the relative price of durables does not change much during the business cycle, then expansions in total consumption must come with a larger increase in the spending on durables than the increase in spending on nondurables.

The Relative Production of Durables

Next, I turn to the supply side. For both goods, I assume that output results from combining capital and labor in a Cobb–Douglas production function with common labor exponent α. In the very short run, it is reasonable to assume that capital is fixed in each sector and so I omit it from the expressions. The log-linear version of the production functions then are:

$$c_t = \alpha l_{ct}, \tag{3}$$

$$x_t = \alpha l_{xt}, \tag{4}$$

where l_{ct} and l_{xt} are the amount of labor used to produce nondurables and durables, respectively. These two equations give the link between the two sides of the first empirical fact by the authors: the relative cyclicality on expenditures across the two sectors will be mimicked by the relative cyclicality of employment.

The markup in a sector is the ratio of the price of its good to the marginal cost of producing it. In turn, since labor is the only variable input, marginal cost equals the wage divided by the marginal product of labor. Using the Cobb–Douglas production function, the log markups in the two sectors are:

$$\mu_{ct} = p_{ct} + c_t - w_t - l_{ct} + \log(\alpha) = \log(\alpha) - s_{ct}, \tag{5}$$

$$\mu_{xt} = p_{xt} + x_t - w_t - l_{xt} + \log(\alpha) = \log(\alpha) - s_{xt}. \tag{6}$$

The second equality uses the definition of the log of the labor share in each sector. This model can therefore also capture the premise, in the authors' work, that labor shares are inversely proportional to markups.

Flexible and Rigid Prices

Finally, given supply and demand, I now discuss how prices are set and markets clear. I start with two extreme cases, to contrast classical models of flexible prices and Keynesian models of sticky prices. In one extreme, prices are flexible and desired markups are constant. Subtracting equation (6) from equation (5), the relative price of durables is

$$p_{xt} - p_{ct} = l_{xt} - x_t + c_t - l_{ct} = (1 - \alpha)(l_{xt} - l_{ct}),$$

where the second equality uses equations (3) and (4). This equation shows how firms pick employment based on the price of their goods. Combining this result with equation (2), linking the demand for goods to their relative price, we end up with:

$$l_{xt} = \frac{l_{ct}}{\alpha\delta + 1 - \alpha}.$$

Therefore, with flexible prices, employment in the durables sector is more volatile than in the nondurables sector. This is consistent with the authors' first finding, as long as $\alpha < 1$, so there are increasing marginal costs. The second finding cannot be explained since the labor share is constant.

In the other extreme, prices are fully rigid, so $p_{xt} = p_{ct}$. Similar steps to the ones described in the previous paragraph show that:

$$l_{xt} = \frac{l_{ct}}{\delta}. \tag{7}$$

With rigid prices, employment in the durables sector is again more volatile than in the nondurables sector, fitting the first fact. Moreover, it is easy to verify that relative employment of durables is more cyclical in the rigid case than with flexible prices.

As for the labor share:

$$s_{xt} - s_{ct} = (1 - \alpha)(l_{xt} - l_{ct}). \tag{8}$$

Compare equations (7) and (8) with the regression equation (1). The rigid-price model can perfectly account for both of the empirical findings. When total output goes up in the economy, employment in both sectors rises, more so in the durables sector, according to equation (7). The relative labor share will, according to equation (8), increase during the boom, precisely as in the data. This is the basis of the authors' conclusion: the rigid-price Keynesian model can fit the facts, whereas a flexible-price classical model cannot.

We can extend the argument to the more plausible case where prices are sticky, but not fully rigid. Combining equations (2) through (6), we get:

$$s_{xt} - s_{ct} = l_{xt} - l_{ct} - \alpha(1 - \delta)l_{xt}.$$

Therefore, for a given size of fluctuations in total output, captured by l_{xt}, a procyclical relative employment is associated with a procyclical relative labor share. The regression estimated by the authors seems to confirm the Keynesian model of labor demand. But is this intuition more general than the previous simple model?

A Digression: The Cyclicality of Markups

Note that the authors did *not* estimate the regression:

$$\log(S_{it}) = \beta \log(\text{lifespan}_i) \times \log(Y_t) + \eta \log(Y_t) + \varepsilon_{it}.$$

That is, their regression equation did not include a term in output, and they never estimated a coefficient like η, which would capture the cyclicality of the labor share in the sector. Therefore, their regression has nothing to say on whether markups are procyclical or countercyclical. The authors' results are consistent with markups for durables being more countercyclical than markups for nondurables, but they are also consistent with durable markups being less procyclical than nondurables markups.

There is a large literature on the cyclicality of markups, including Bils (1987), Rotemberg and Woodford (1992, 1999), Basu and Fernald (1997), Hall (2009), and Nekarda and Ramey (2010). The main obstacle this literature has faced is that Keynesian models predict that markups are countercyclical in response to monetary shocks, since prices do not move but marginal costs rise with output, but markups are procyclical in response to technology shocks that lower marginal costs. To test the models, one needs a measure or an instrument to isolate one type of shock.

This is not so in the authors' regression. In the theory in the previous section, I derived the authors' prediction without ever having to state what aggregate shock drives the business cycle. Employment in the durables sector was more volatile than nondurables employment and the relative labor share of durables was procyclical. This holds always, via the reduced-form relations implied by the theory, and not only in the response or partial derivatives of these variables with respect to some shock. The authors' approach is commendable because by focusing on relative markups, they sidestepped the main obstacle the literature had faced so far.

Sticky Prices Do Not Imply a Countercyclical Relative Markup

While the previous derivations suggest that Keynesian labor demand and sticky prices may explain the facts, they do not show that it *must* be so. This would only be the case if, first, sticky-price models always pre-

Table C1
Calibration

Parameter	Value	Target
β	0.99	4 percent annual real interest rate
α	0.65	Labor share in aggregate income
δ	0.025	Quarterly depreciation of durables
ν	6	Average markup of 20%
ψ	0.463	Ratio of nondurable to durable expenditures of 3
ϕ	6.632	Steady-state hours worked 0.33

dicted a countercyclical relative markup, and second, if flexible-price models were never able to do so.

Starting with the first premise, I simulated the model of Barsky, House, and Kimball (2007) to investigate it. The household chooses consumption and labor supply exactly as in the second section, but now it also allocates total expenditure across varieties of the two types of consumption goods, according to a Dixit–Stiglitz aggregator with parameter ν. The firms still operate identical Cobb–Douglas production functions, but there is now a continuum of them, of measure 1 in each sector, and operating under monopolistic competition. Capital is still fixed on aggregate and in each sector, but now can be reallocated across firms within a sector at no cost. Finally, the firms face nominal rigidities à la Calvo, with θ_x and θ_c giving the share of durables and nondurables firms, respectively, that do not adjust their price every period.

I set the parameter values in a standard way, described in table C1. Still following Barsky, House, and Kimball (2007), I assume monetary policy sets an exogenous process for nominal GDP, which follows a random walk, and I solve the model by log-linearizing around the nonstochastic steady state. Figure C1 shows the impulse response of several variables to a 1 percent shock at date 0 when prices adjust on average every four quarters in both sectors. The model is consistent with the authors' facts: durables expenditure is more cyclical than nondurables expenditure, and the relative durables markup is countercyclical. Moreover, the absolute markups are also countercyclical in both sectors.

Figure C2 further confirms the success of the model. It shows the date 0 response for any value of the price rigidity parameter, but keeping it the same for both sectors. In all the cases, the relative output of durables is procyclical while the relative markup is countercyclical.

Nevertheless, these positive results are not robust. In figure C3, I perform the same calculation but now set $\theta_c = 1.5\theta_x$, so that nondurables

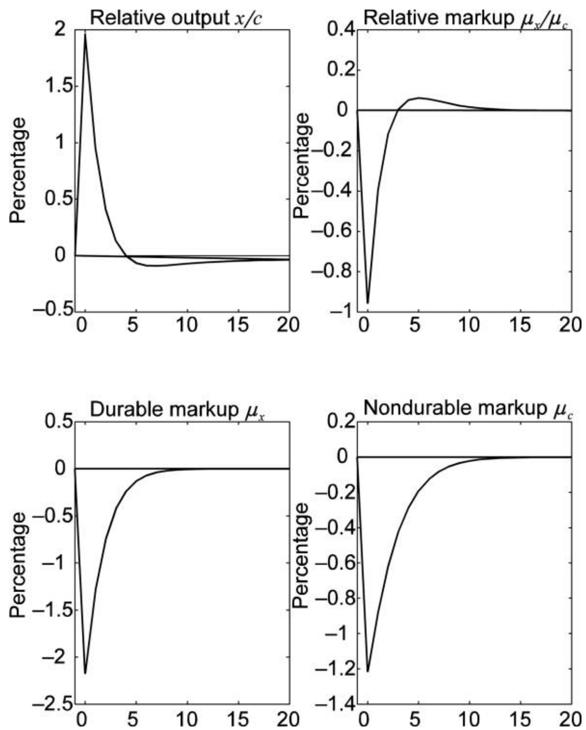

Fig. C1. Impulse responses to a 1 percent monetary shock with $\theta_c = \theta_x = 0.75$

prices adjust less often than durables. Now, the cyclicality of the relative expenditure on durables depends on the frequency of price adjustment. If both sectors adjust prices on an average of every six months, then the model predicts the opposite of the first empirical finding. Moreover, the relative markup of durables is procyclical for all parameters, so the second empirical finding is also at odds with this sticky-price model.

Figure C4 instead varies θ_c between 0.01 to 0.99 with equal spaces, while varying θ_x between 0.01 and 0.75, also with equal spaces. Therefore, at the left of the diagram, durables and nondurables adjust prices equally very frequently, and as we move to the right, nondurables prices are progressively more sticky than durables. Now, relative expenditure on durables is procyclical always in line with the first finding. Yet, the relative markup on durables is procyclical if the economy is very rigid, but countercyclical if prices are very flexible.[1]

Therefore, the authors' findings are useful and informative, but they are not tests of the Keynesian model. Figures C1 through C4 show that a

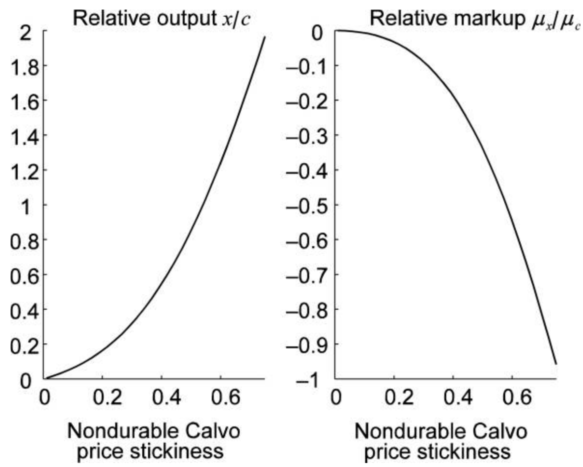

Fig. C2. Period-0 impact of monetary shock when $\theta_c = \theta_x$

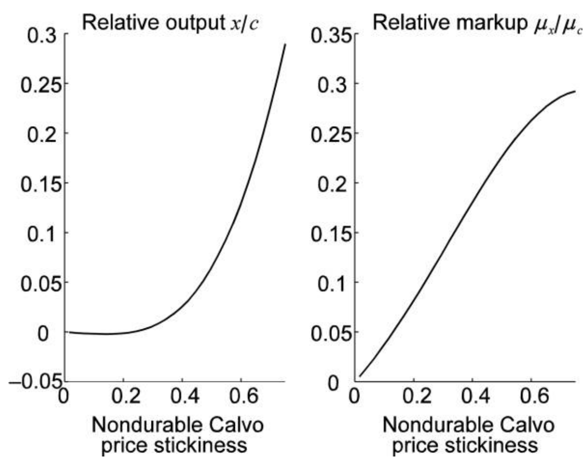

Fig. C3. Period-0 impact of monetary shock when $\theta_c = 1.5\theta_x$

countercyclical relative markup of durables is not a fundamental property of a new Keynesian model. It is not even robustly associated with procyclical relative employment or expenditure on durables. Moreover, price stickiness can matter in a nonmonotonic way, and figure C4 gives an example where prices being closer to being flexible is actually more likely to generate a countercyclical relative markup on durables, while more rigid prices make it more likely that the relative markup moves in the opposite way to the authors' empirical findings. I conclude from

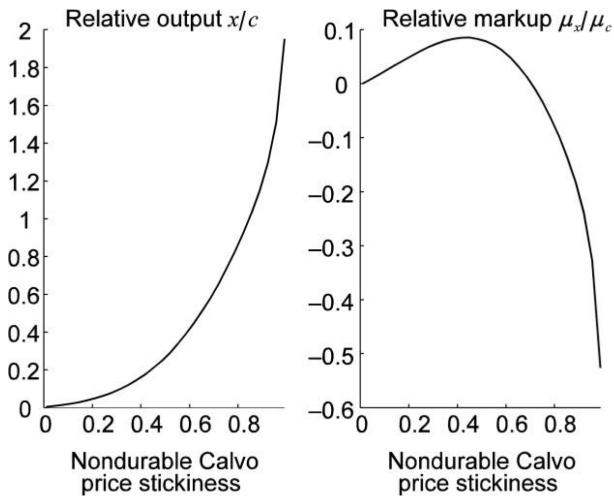

Fig. C4. Period-0 impact of monetary shock with asymmetric price stickiness

these that the empirical results in this paper do not confirm or reject the sticky-price model.

Flexible Prices Are Not Inconsistent with Countercyclical Relative Markups

Oh (2012) proposed a tractable and insightful model of durables when there is a secondhand market. In his model, the stock of durables evolves according to:

$$D_t = (1 - s_t)(1 - \delta_{t-1})D_{t-1} + D_t^N,$$
$$X_t = P_{dt}D_t^N - P_{ut}s_t(1 - \delta_{t-1})D_{t-1}.$$

If the share of durables that is sold, s_t, equals zero, then this is just the standard law of motion for durables that we saw in the second section. But, if agents can sell their durables after depreciation, this allows them to lower their stock, and get a price P_{ut} in returns. Net spending on durables then equals the amount paid for new durables D_t^N times the price P_{dt} minus the revenues from selling old durables.

Oh (2012) further assumes that depreciation accelerates at a quasi-geometric rate. In the first period that a durable is used, the depreciation rate is $\rho\delta$, with $\rho < 1$, whereas in all subsequent periods the depreciation rate rises to δ. This formulation implies that selling used durables and buying new ones lowers the depreciation rate of the overall stock, capturing some of the benefit from replacing old with new.

Turning to the supply of durables goods, there is a firm producing new goods, and a continuum of firms buying and refurbishing old durables, which are then sold in the same market as the new ones. Oh (2012) assumes these firms play a sequential oligopoly game, where first, the secondhand retailers choose whether to enter the market; second, the new durable firm sets the price for the good; and third, the entrants pick how much to supply. The new-durables firm plays the role of a dominant leader, whereas the secondhand retailers are a price-taking competitive fringe.

Working by backwards-induction, given that the secondhand retailers will supply the amount M_{it} of the durable variety i, the new-goods leader chooses the price P_{idt} to solve:

$$\max(P_{idt} - MC_{idt})X_{it},$$

$$X_{it} = D_t^N \left(\frac{P_{idt}}{P_{dt}}\right)^{-\nu} - M_{it}.$$

The residual demand from the secondhand firms then leads to a countercyclical desired markup. When output is booming and the secondhand market is producing a great amount, the residual elasticity of demand for new goods is smaller, so the desired markup is smaller as well. This argument applies to durable goods only. Therefore, this model, which has flexible prices, generates a countercyclical relative markup for durables with fixed capital, fitting the findings of the authors. There is no price rigidity, but markups move nonetheless because changes in activity in the secondhand market alter the competitive pressure on the monopolist new-goods firm.[2]

Conclusion

In this discussion I focused on two of the many facts that Bils, Klenow, and Malin brought to the table: relative employment and relative labor share of durables are procyclical. These and the other facts in this paper should guide research in the years to come. More generally, using cross-section characteristics, like durability, to infer different cyclicality of industries over time is an insight that promises to yield many more interesting findings.

However, I expressed some skepticism that these facts can provide a test that accepts or rejects the broad class of Keynesian models of nominal rigidities. I showed that some calibrations of a standard model of durables with sticky prices could produce the opposite of what the authors find in the data, while a simple model of durables with a second-hand market and flexible prices is consistent with the facts. This does not take away from the main accomplishment of the authors: to convincingly show that, as previously argued by Barsky, House, and Kimball (2007), the durability of goods has crucial implications for models of goods' pricing.

Endnotes

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1. Barsky, House, and Kimball (2007) argue that durables prices are less sticky than nondurables, and even model them as perfectly flexible. The authors instead argue that the two sectors are equally sticky. The in-between that I consider in figures C3 and C4 is hard to reject in the data.

2. Parker (1997) provides another flexible-price model where the relative markup for durables is countercyclical because buyers can time their purchases of durables. Note that to fit the facts, it is not enough to generate countercyclical desired markups, which many models are able to deliver. The models must predict that *relative* markups for durables are countercyclical.

References

Barsky, R. B., C. L. House, and M. S. Kimball. 2007. "Sticky-Price Models and Durable Goods." *American Economic Review* 97 (3): 984–98.

Basu, S., and J. G. Fernald. 1997. "Returns to Scale in US Production: Estimates and Implications." *Journal of Political Economy* 105 (2): 249–83.

Bils, M. 1987. "The Cyclical Behavior of Marginal Cost and Price." *American Economic Review* 77 (5): 838–55.

Hall, R. E. 2009. "By How Much Does GDP Rise If the Government Buys More Output?" *Brookings Papers on Economic Activity* 2:183–231.

Nekarda, C. J., and V. A. Ramey. 2010. "The Cyclical Behavior of the Price-Cost Markup." University of California, San Diego, Manuscript.

Oh, H. 2012. "The Role of Durables Replacement and Second-Hand Markets in a Business-Cycle Model." Columbia University, Manuscript.

Parker, J. A. 1997. "The Timing of Purchases, Market Power, and Economic Fluctuations." Social Science Research Insitute Working Paper 9724.

Rotemberg, J. J., and M. Woodford. 1992. "Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity." *Journal of Political Economy* 100 (6): 1153–207.

———. 1999. "The Cyclical Behavior of Prices and Costs." In *Handbook of Macroeconomics*, vol. 1, edited by J. B. Taylor and M. Woodford, chapter 16, 1051–135. North Holland: Elsevier.